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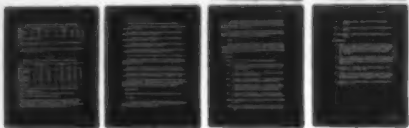
OFFICE OF THE PRODUCT MANAGER COMPUTERIZED TRAINING S--ETC F/G 9/2  
INSTRUCTIONAL EFFECTIVENESS OF THE PLATO IV PLASMA TERMINAL.(U)  
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INSTRUCTIONAL EFFECTIVENESS OF THE PLATO IV  
PLASMA TERMINAL

OFFICE OF THE PRODUCT MANAGER  
COMPUTERIZED TRAINING SYSTEMS PROJECT  
FORT MONMOUTH, NEW JERSEY

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Report CTS-TR-75-2

Instructional Effectiveness of the  
PLATO IV Plasma Terminal

Alexander A. Longo  
Janet M. Lamb

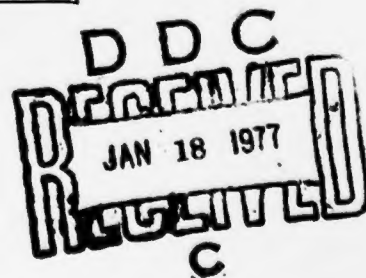
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Self-paced Training						
Individualized Instruction						
Curriculum Development						
Instructional Strategies						
Peer Instruction						

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## NOTICES

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## FOREWORD

The purpose of this study was to evaluate the effectiveness and efficiency of the PLATO IV Plasma terminal from an instructional point of view. The instructional basis for this evaluation consisted of six mini-CAI/CMI programs developed by the instructional programming staff of the U. S. Army Computerized Training System Project, Fort Monmouth, N. J. The primary instructional device which conveyed these instructional materials consisted of four PLATO IV terminals which are interfaced with the PLATO IV Computer-based Educational System at the University of Illinois via telecommunication lines. The basic results indicated that while peer training achievement was equivalent to individual training achievement, peer training was conducted in significantly less time than individual training.



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## Table of Contents

	Page
Foreword . . . . .	i
Introduction . . . . .	1
Hypotheses . . . . .	1
Background and Significance . . . . .	2
Procedure . . . . .	3
A. Sampling . . . . .	3
B. Briefing . . . . .	3
C. Instruments . . . . .	4
D. Instructional Materials . . . . .	4
E. Statistical Design/Analysis . . . . .	4
Results . . . . .	4
Significance of Findings . . . . .	7
Conclusions . . . . .	7
A. Specific . . . . .	7
B. General . . . . .	8
Glossary . . . . .	8
References . . . . .	9

## Tables

1. Individual/Peer Group Pre-Training Characteristics . . . . .	5
2. Significance of Pre vs Posttest Achievement (Within) . . . . .	5
3. Significance of Learning Gain/Posttest Achievement (Between) . . . . .	6
4. Significance of Mini-Lesson/Total Package Time (Between) . . . . .	6



## Instructional Effectiveness of the PLATO IV Plasma Terminal

### 1. INTRODUCTION

The purpose of this study was to evaluate the effectiveness and efficiency of the PLATO IV (Programmed Logic for Automatic Teaching Operation) Plasma terminal from an instructional point of view. The instructional basis for this evaluation consisted of six mini-CAI/CMI programs developed by the instructional programming staff at the U. S. Army Computerized Training System (CTS) Project, Fort Monmouth, N. J. The primary instructional medium which conveyed most of the instructional materials consisted of four PLATO IV Plasma terminals which are interfaced with the PLATO IV Computer-based Educational System at the University of Illinois via telecommunication lines. The scope of evaluating the effectiveness and efficiency of the PLATO IV terminals for presentation of instructional materials included:

A. An analysis of learning gain (operationally defined as the difference between pre and posttest scores) on students training alone at the PLATO terminal (Individual-Learning, "I-L", mode);

B. An analysis of learning gain on students training together at a PLATO terminal (Peer-Learning, "P-L", mode);

C. Comparison between individual versus peer-learning groups on: learning gain, final achievement and completion time scores.

### 2. HYPOTHESES

It was hypothesized that:

I. The difference between the pre and posttest achievement means within the two study groups will be significant;

II. The difference between the learning gain means between the two study groups will not be significant;

III. The difference between the posttest achievement means between the two study groups will not be significant;

IV. The difference between the course total time means and sub-lesson means will not be significant.

For purposes of conducting and interpreting the statistical analyses, the null

hypothesis for each of the above expectations will be conventionally stated that the difference between any two tested means will be nonsignificant.

### 3. BACKGROUND AND SIGNIFICANCE

The CTS Project has been engaged in the use and testing of four PLATO IV terminals. These terminals were designed for use in the PLATO IV Computer-based Educational System by the Computer-based Education Research Laboratory (CERL) at the University of Illinois.<sup>(2)</sup> The CTS investigation of these terminals is being performed in conjunction with a program sponsored by the Advanced Research Projects Agency (ARPA) of the Department of Defense. This program originated from a proposal by the University of Illinois for the evaluation of their PLATO IV Computer-based Education System for a Volunteer Armed Services Personnel Program.<sup>(1)</sup> The four plasma display terminals were allocated to CTS by ARPA initially for the primary purpose of training instructional programmers preliminary to the acquisition of the Army's Computerized Training System (CTS) due to be fully installed approximately by May 1975. However, the development of a plan for a more extensive use and evaluation of the PLATO IV plasma terminal was considered necessary.<sup>(4)</sup> The task confronting the CTS Evaluation Division is to assess the planned alternative uses to which the PLATO terminals can be put and determine the order which it considers most expedient for their evaluation. This determination must be tempered, of course, by the primary commitment of the CTS Evaluation Division, i.e., to develop and implement plans for the test and evaluation of the Army's own CTS Project. The alternative selected for this initial use and evaluation of the PLATO terminal comprises the topic of this study.

In consonance with the objectives of the PLATO IV demonstration and evaluation program, as proposed by the CERL department of the University of Illinois, the alternative uses of the PLATO IV terminals submitted by CTS include the following:

- A. Prepare concise materials aimed at the development of technical and occupational skills;
- B. Train instructional programmers in the development of instructional materials;
- C. Develop techniques and procedures for developing and presenting computer-based course materials;
- D. Evaluate system and terminal reliability;

E. Evaluate the effectiveness and efficiency of the PLATO IV Plasma terminal from an instructional point of view.

In order to expedite the above noted PLATO terminal uses and evaluation, each alternative was defined as a task area which then was further subdivided into specific subtasks of manageable proportions for assessment purposes. For example, one of the task areas, which corresponds with objective "E" above, includes three subtasks related to the evaluation of the effectiveness and efficiency of the course materials developed for presentation by the system: (a) evaluation of course materials; (b) student acceptance; and, (c) instructor acceptance. Due to several readily available mini-lessons made possible by implementation of alternative "A" above, subtask "a" (evaluation of course materials) was selected as the next PLATO area for investigation. The instructional materials evaluated were:

- o Introduction to PLATO IV Plasma Terminal
- o First Aid
- o Ohm's Law
- o Series Circuits
- o Parallel Circuits
- o Troubleshooting

For study purposes these six mini-lessons were organized into a complete self-paced instructional package.

#### 4. PROCEDURE

A. Sampling. The total study sample consisted of 87 students. This sample was subdivided into two study groups: (a) individual-learning (I-L) group: n=35; and, (b) peer-learning (P-L) group: n=52 (26 pairs). All students were randomly selected from regular Army personnel who were in a holding status in preparation for initial or further MOS (Military Occupational Specialty) training at the US Army Communications Electronics School (USACES), Fort Monmouth, N. J., and also randomly assigned to the two study groups.

B. Briefing. Students were briefed by CTS staff personnel concerning classroom modus operandi: e.g., rest breaks, sign-on procedures to the PLATO IV terminal, and relationship of pairs in the peer-learning mode.

C. Instruments. Two achievement instruments were employed: (a) a pretest on achievement; and, (b) a posttest on achievement. The pre and posttests were administered immediately prior to and following the student learning task. These tests were identical except for rewording of instructions as appropriate.

D. Instructional Materials. The instructional materials consisted of three Direct Current Fundamentals lessons using a CAI mode of presentation: one Troubleshooting Procedures lesson using a CDI mode of presentation; and, one First Aid and Safety lesson using a CMI mode of presentation. An introductory lesson preceded these lessons, orienting the students on the use of the PLATO IV terminal keyboard, making corrections and sending answers to the computer. The instructional package was structured as follows: (a) Introduction; (b) First Aid/Safety or Troubleshooting; (c) Ohm's Law; (d) Series Circuits; (e) Parallel Circuits; and, because of necessary scheduling of students due to lack of availability of secondary devices, First Aid/Safety or Troubleshooting was given last to some students.

E. Statistical Design/Analysis. In order to test the null hypothesis: (i.e., no difference exists between the obtained means) for each of the hypotheses stated in section three above, the "t" test of significance was employed.<sup>(3)</sup> As appropriate, two types of "t" tests were used: (a) "t" test for the difference between correlated means: applied to the pre vs posttest means (same subjects); and, (b) "t" test for the difference between independent means: applied to the individual vs peer-learning means (different subjects). Where the assumption for homogeneity of variances was rejected, the required "df" was adjusted by the Welch test prior to the "t" test.<sup>(5)</sup> Since this investigation represents one of a series of exploratory PLATO terminal studies, the .05 level of significance was adopted.

## 5. RESULTS

The findings relating to the nature of the study samples and to the hypotheses of the study are contained in Table 1-4. Table 1 contains information on the pre-training characteristics of the two study groups (I-L/P-L). As indicated, no significant difference ( $p > .05$ ) was obtained between the two groups on three matching variables: EL, GT, and Pretest regarding both means and S. D.'s (except for the EL S.D.). From this data, it was concluded that the two study groups were matched sufficiently to warrant further statistical analyses of the stated hypotheses.

Table 1

## Individual/Peer Group Pre-Training Characteristics

Matching Variable	N	Individual		N	Peer		t <sup>1</sup>	p
		Mean	SD		Mean	SD		
EL <sup>2</sup>	35	115.23	11.60	52	117.75	16.51	.84 <sup>3</sup>	.41
GT <sup>2</sup>	35	110.00	13.23	50 <sup>5</sup>	113.08	16.37	.92 <sup>4</sup>	.36
Pretest <sup>2</sup>	35	10.86	3.66	52	11.19	4.28	.38	.71

<sup>1</sup>t test: for independent means

<sup>2</sup>See Glossary

<sup>3</sup>Assumption of equal variances rejected: df adjusted by Welch's test

<sup>4</sup>Assumption of equal variances accepted: hence, variances pooled

<sup>5</sup>Two scores were unavailable

Tables 2-4 contain the results pertaining to the hypothesis testing regarding achievement and completion time within and between the two study groups. The pre vs posttest achievement results within the two groups are contained in Table 2. As indicated, the mean difference between the pre and posttest measures was highly significant for both groups ( $p < .001$ ).

Table 2

## Significance of Pre vs Posttest Achievement: Within Groups

Study Group	N	Pretest		Posttest		t <sup>1</sup>	p
		Mean	SD	Mean	SD		
Individual	35	10.86	3.66	14.31	3.06	8.13	.001
Peer	52	11.19	1.28	13.92	3.68	7.67	.001

<sup>1</sup>t test: for correlated means

The learning gain (posttest - pretest) and posttest achievement results between the two groups are contained in Table 3.



Table 3

## Significance of Learning Gain/Post Test Achievement: Between Groups

Study Variable	Individual Gp.			Peer Gp.			$t^1$	p
	N	Mean	SD	N	Mean	SD		
Learning Gain	35	3.63	2.32	52	2.85	2.40	1.51	.13
Posttest	35	14.34	3.06	52	13.92	3.68	.56	.57

<sup>1</sup>t test: for independent means

As indicated the mean difference between the two groups on both learning gain and posttest was nonsignificant ( $p > .05$ )

The separate mini-lesson and total package completion time results between the two groups are contained in Table 4.

Table 4

## Significance of Mini-Lesson/Total Package Time: Between Groups

Mini-Lesson	Individual Gp.			Peer Gp.			$t^2$	p
	N	Mean <sup>4</sup>	SD	N <sup>1</sup>	Mean	SD		
Introd. PLATO IV	35	9.01	2.68	26	8.42	2.27	.91	.37
First Aid/Safety	35	30.85	18.09	26	22.46	17.77	1.81	.08
Ohm's Law	35	28.13	9.85	26	23.94	8.02	1.78	.08
Series Circuits	35	17.31	7.89 <sup>3</sup>	26	16.50	4.39 <sup>3</sup>	.52	.61
Parallel Circuits	35	62.87	23.21 <sup>3</sup>	26	53.98	13.42 <sup>3</sup>	1.88	.07
Troubleshooting	35	36.54	8.36	26	32.96	10.13	1.51	.14
-----								
Total Package	35	3.08 <sup>4</sup>	.87	26	2.61 <sup>4</sup>	.69	2.30	.03

<sup>1</sup># of pairs used: most conservative N for peer group (using  $\bar{X}$  time of pairs)

<sup>2</sup>t test: for independent means

<sup>3</sup>assumption of equal variances rejected: df adjusted by Welch method

<sup>4</sup>total time: in hours/mini-lesson time: in minutes

As indicated, the mean difference between the two groups on completion time for each of the mini-lessons was non-significant ( $p > .05$ ) although three lessons approached significance. Further, the mean difference between the groups on total completion time (across all lessons) was significant ( $p < .05$ ).



## 6. SIGNIFICANCE OF FINDINGS

An overall assessment of the above results indicates the following:

A. The individual and peer groups were adequately matched for comparative purposes. (Table 1)

B. Both the I-L and P-L groups demonstrated a significant degree of learning between their pre-posttest. (Table 2)

C. Comparatively, both groups demonstrated an equivalent degree of learning gain (posttest - pretest). (Table 3)

D. Both groups demonstrated an equivalent degree of posttest achievement in a test covering all mini-lessons taken. (Table 3)

E. The peer group completed the total package of instructional material in significantly less time than the individual group. (Table 4)

Thus, with respect to the stated hypotheses (Part 2), the following is noted:

Hypothesis I: Null hypothesis rejected. As anticipated, a significant difference was obtained between the pre-posttest achievement means within the two study groups. (Table 2)

Hypothesis II: Null hypothesis accepted. The difference between the learning gain means between the two study groups was not significant. (Table 3)

Hypothesis III: Null hypothesis accepted. The difference between the post-test achievement means between the two groups was not significant. (Table 3)

Hypothesis IV: Null hypothesis accepted for mini-lessons, but rejected for total instructional package. The difference between each mini-lesson mean between the two study groups was not significant; however, contrary to expectations the difference between the total course means was significant. (Table 4)

## 7. CONCLUSIONS

Based upon the conduct of this study the following conclusions are made:

A. Specific:

(1) The basic potential of the PLATO IV Plasma terminal as an instructional device was supported by the significant learning gain observed between the pre and post-achievement scores for both study groups.

(2) The basic potential of peer-learning to enhance student achievement in contrast with individual-learning in computer-based instruction was not supported by the findings. Both groups achieved equally as well on both their learning gain and final achievement scores.

(3) The potential for the peer-learning technique to accelerate student learning was supported by the findings. The peer group completed the learning package in significantly less time than the individual group.

#### B. General:

The PLATO IV Plasma terminal provides a very useful medium for the conduct of training/learning research. Further, its capability for a wide range of statistical analysis was noted and utilized in this study. Therefore, the high potential of such computer-based interactive display devices is to be recognized and exploited.

### 8. GLOSSARY

- o PLATO: Program Logic For Automatic Teaching Operation.
- o Plasma: A special type of display screen which does not require regeneration of the display signal such as is required by a conventional CRT scope.
- o CAI: Computer Assisted Instruction (i.e., instruction is presented on line via a computer terminal).
- o CDI: Computer Directed Instruction (i.e., instruction is presented off line but control and direction is maintained on line).
- o CMI: Computer Managed Instruction (i. e., instruction is presented off line apart from a computer terminal and not under its immediate control except for periodic testing/prescription.
- o CTS: Computerized Training System. A prototype Army Project which will combine CAI-CMI-CDI into one instructional system.
- o Achievement/Learning Gain: The difference between the pre and posttest scores.
- o Secondary Device: An on/off line instructional device used as an adjunct device for training in addition to a primary medium of instruction.

- o EL:        Electronics Repair - Subtest of the Army Classification Battery Subtests.
- o GT:        General Technical - Subtest of the Army Classification Battery Subtests.
- o Pretest/Posttest - Special Achievement test developed by in-house personnel.

## 9. REFERENCES

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